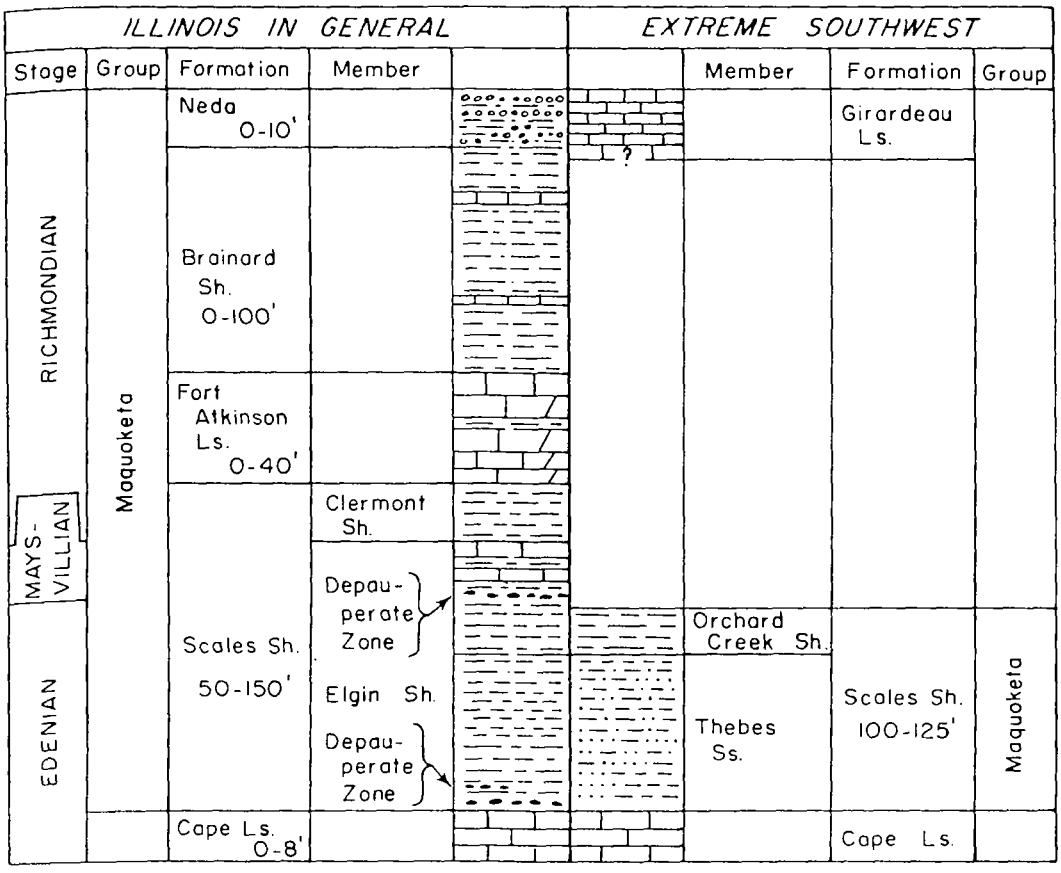

Fig. O-25—Columnar section of the Cincinnatian Series (after Templeton and Willman, 1963).

ta Group strata south of Galesburg in Knox County. It is also absent in subsurface in northeastern Illinois, but equivalent beds may be included in the Wise Lake Formation. The lower 20 feet of the Dubuque Formation grades uniformly from the pure, thick-bedded dolomite of the underlying Wise Lake Formation to shaly dolomite. A 4-inch bed of dolomite set off by relatively strong shale partings occurs 8 feet above the base of the formation and is a widely traceable marker bed. In the upper part of the formation, beds of dolomite 1-6 inches thick that are dense, fine-grained, and argillaceous are interlayered with beds of dolomitic shale 1-8 inches thick. A thin bed of dark brown shale occurs 20 feet below the top. Calcite-filled vugs are common in the upper 2 feet. *Paucicrura* [*Dalmanella*], *Sowerbyella*, *Pseudolingula iowensis*, and crinoidal debris are common in the shaly beds in the upper 10 feet. Some beds contain numerous, minute, brown-walled spore-like forms that are probably algae. The Dubuque is overlain unconformably by the Maquoketa Group. Although the contact is sharp, there is slight, if any, truncation of the Dubuque in the outcrop area in Illinois. The Dubuque is equivalent to the *Oxoplecia* Zone of early reports. It is correlated with the Hillier Member at the top of the Cobourg Formation in New York, the Cynthiana Limestone in Kentucky, and the Catheys Formation in Tennessee.

CINCINNATIAN SERIES

The Cincinnatian Series (Meek and Worthen, 1865, p. 155), named for Cincinnati, Ohio, is the uppermost series of the Ordovician System (fig. O-4). It is separated by unconformities from the Champlainian Series below and the Silurian Alexandrian Series above. In Illinois the Cincinnatian Series includes the Cape Limestone, the Maquoketa Group, and the Girardeau Limestone (fig. O-25). Where not affected by sub-Silurian erosion (fig. O-26), the series is 180-350 feet thick.

The Cincinnatian strata in Illinois were long believed to be equivalent to only the uppermost (Richmond) strata in the type region at Cincinnati (fig. O-27) but now are correlated

in Illinois. The Neda Formation and the Girardeau Limestone at the top may be younger than the youngest strata in the type Cincinnatian.

The unconformity at the base of Cincinnatian strata is marked by the sharp truncation of the upper half of the Trentonian Galena Group limestone and dolomite by the Cincinnatian strata in an east-west belt across central Illinois. The Dubuque and Wise Lake Formations and the upper part of the Dunleith Formation were eroded in this belt and are not known south of there, although they may be present in subsurface in the southeastern part of the state where the Galena Group thickens. The Lower Depauperate Zone at the base of the Maquoketa Group is continuous across the truncated formations. Impact of a large meteorite near Glasford in western Illinois probably accounts for the intensive deformation of the Champlainian and older strata before deposition of the Maquoketa Group in that area (Buschbach and Ryan, 1963).

Edenian Stage

The Edenian Stage of the Cincinnatian Series (Newberry, 1873, table opp. p. 89; Twenhofel et al., 1954, chart), the basal stage, is based on the Eden Group, named for Eden Park in Cincinnati, Ohio. In Illinois it includes the Cape Limestone and the lower part of the Scales Shale (essentially the part underlying the Upper Depauperate Zone), which consists of the Thebes Sandstone Member and probably the Orchard Creek Shale Member in extreme southern Illinois and the middle and lower parts of the Elgin Shale Member elsewhere. The presence of dark brown to nearly black shale is characteristic of the Elgin Shale Member and lower Edenian strata in the type region of the Cincinnatian.

Maysvillian Stage

The Maysvillian Stage of the Cincinnatian Series (Foerste, 1905, p. 150; Twenhofel et al., 1954, chart), which overlies the Edenian Stage, is named for Maysville, Kentucky. In Illinois it consists of strata in the upper part of the Scales Formation, including the Upper Depauperate Zone and the overlying argillaceous limestone beds that contain *Isotelus* in abundance. The Girardeau Limestone in the extreme southwestern part of Illinois is approximately at this position, but its relation to the Upper Depauperate Zone is not known. Its fauna has long been considered to be more closely related to Silurian than to Ordovician faunas (Savage, 1917), and it therefore probably is late Richmondian in age.

Richmondian Stage

The Richmondian Stage of the Cincinnatian Series (Winchell and Ulrich, 1897, p. ciii; Twenhofel et al., 1954, chart), the uppermost stage, is named for Richmond, Indiana. In Illinois it includes the uppermost part of the Scales Shale, the Fort Atkinson Limestone, the Brainard Shale, the Neda Formation, and the Girardeau Limestone. The red shales of the Neda suggest correlation with red shales and sandstones in the Queenston and Juniata Formations at the top of the Cincinnatian Series in the Appalachian region.

Cape Limestone

The Cape Limestone (Templeton and Willman, *in* Gutstadt, 1958b, p. 524), the oldest Cincinnatian formation, is named for Cape Girardeau, Missouri, and the type section is an exposure on Main Street just north of Broadway in Cape Girardeau, where the formation is 8.5 feet thick, the maximum thickness observed (Templeton and Willman, 1963, p. 134). The Cape Limestone has a patchy distribution in the outcrop area in Missouri from St. Louis to Cape Girardeau. It occurs in the southwestern part of Illinois, where Cincinnatian strata deeply truncate the Trentonian Series, but it is exposed only at Valmeyer, Monroe County (SW 3, 3S-11W), where it is 1.5 feet thick. A few small outcrops formerly occurred near Thebes in Alexander County but are now covered. The Cape Limestone occurs mainly in shallow channels eroded in the top of the Dunleith Formation. In the northern part of the area, it is overlain by the Elgin Shale Member of the Scales Shale, as shown by the presence of the Lower Depauperate Zone above it at Valmeyer. In the southern part of the outcrop area, it is overlain by the Thebes Sandstone Member of the Scales. The Cape Limestone is a light gray to reddish gray, coarse-grained, fossiliferous calcarenite. It occurs in medium to thick beds with weak shaly partings. It has a large fauna characterized by brachiopods, particularly *Lepidocyclus capax*, and crinoids. The Cape Limestone was for many years called the Fernvale Limestone. It is correlated with the Fernvale Limestone in Arkansas and Oklahoma but not with the type Fernvale in Tennessee, which, being Richmondian in age, is much younger.

Maquoketa Shale Group

The Maquoketa Shale Group (White, 1870, p. 180-182) is named for exposures on the Little Maquoketa River in Dubuque County, Iowa. It underlies most of Illinois (fig. O-26), unconformably overlying the Galena Group and truncating the upper half of the Galena in the southern part of the state, except for the southwestern area where it rests conformably

on the Cape Limestone. It is unconformably overlain by Silurian strata, which locally truncate the upper half of the Maquoketa, except in the southwestern area where it is overlain conformably by the Girardeau Limestone. In western Illinois the sub-Kaskaskia unconformity at the base of the Middle Devonian rocks cuts through the Silurian strata and into the Maquoketa, and farther west near the Mississippi River it completely truncates the Maquoketa (fig. O-26). The sub-Absaroka unconformity at the base of the Pennsylvanian rocks locally cuts through the Maquoketa along the La Salle Anticline (fig. P-4). Except where thinned by the unconformities, the Maquoketa is 180 to nearly 350 feet thick.

Throughout most of Illinois the Maquoketa Shale Group (fig. O-25) consists of a lower unit, dominantly shale (the Scales Shale), overlain by a middle limestone (the Fort Atkinson Limestone), and an upper shale (the Brainard Shale) (DuBois, 1945; Gutstadt, 1958b; Templeton and Willman, 1963; Buschbach, 1964). In northern Illinois, the Neda Formation (red shale and hematitic oolite) is locally present at the top of the group. In extreme southwestern Illinois, the Maquoketa Group includes only the Scales Shale. Some of the complex facies variations within the Maquoketa Group in Illinois have been shown by DuBois (1945, fig. 3), but his middle zone is not equivalent in all areas to the Fort Atkinson Limestone, which is now restricted to the section in which limestone or dolomite is dominant.

The Maquoketa Shale contains two zones with distinctive pyritic and phosphatic beds, called depauperate zones because they contain only small fossils, largely a coquina of mollusks. The Lower Depauperate Zone, at the base of the Scales Shale, is widely present throughout the state, but the Upper Depauperate Zone, near the top of the Scales, has been found only locally in central and northeastern Illinois. The limestone beds and the calcareous shale beds in the Maquoketa Group generally contain a large and varied fauna (fig. O-5). Large brachiopods are common, and branching bryozoans are especially abundant. In a zone near the top in northwestern Illinois, specimens of *Phragmopora* that reach 4 inches in diameter are locally abundant. Some beds of calcarenite consist largely of bryozoan and crinoidal debris.

Various group and formation names have been used in differentiating the type Cincinnatian (Weiss and Norman, 1960). In southeastern Indiana, part of the type region, the Cincinnatian strata are assigned to the Maquoketa Group (Gray, 1972). The Maquoketa Group is equivalent to Collingwood and Queenston strata in Ontario and New York, to the Sylvan Shale to the southwest, and to the Reedsville Shale and the Sequatchie Formation to the south and southeast of Illinois.

Scales Shale

The Scales Shale (Templeton and Willman, 1963, p. 135, in which it was called the Scales Formation), the "lower shale" formation in the Maquoketa Group in most of Illinois, is named for Scales Mound, Jo Daviess County, and the type section is a railroad cut on the west side of the town (SW NE SW 26, 29N-2E). Only the lower 30 feet, overlying the Dubuque Formation, is exposed in the type section, but the upper 18 feet is exposed 5 miles east in another railroad cut (SW SW SW 15, 29N-3E). The Scales Shale is extensive but is exposed only in northwestern Illinois and in small areas near West Point Landing in Calhoun County, Valmeyer in Monroe County, and Thebes in Alexander County. The formation is generally 75-100 feet thick, but it ranges from 50-150 feet thick. The lower part is generally dark gray to dark brown shale, which is differentiated as the Elgin Shale Member. At the top of the Scales is a gray shale—the Clermont Shale Member—that contains beds of argillaceous limestone. In the southwestern part of Illinois, brown sandstone and siltstone at the base of the Scales is differentiated as the Thebes Sandstone Member, and the shale overlying it is the Orchard Creek Shale Member. The Scales Shale has been called "the lower brown shale member" (Willman and Payne, 1942), "the lower shale zone" (DuBois, 1945), or the Scales Formation (Templeton and Willman, 1963).

Elgin Shale Member—The Elgin Shale Member of the Scales Shale (Calvin, 1906, p. 60, 98) is named for Elgin, Fayette County, Iowa. It forms the major part of the formation and is partly exposed in many localities in northwestern Illinois and locally in the other outcrop areas of the Maquoketa Group. Although dominantly shale, and in some areas almost entirely shale, the member contains beds of dolomite, limestone, siltstone, and sandstone. The lower two-thirds of the shale is commonly dark gray or dark brown, and locally in eastern Illinois it is nearly black. The shale generally becomes lighter in color to the northwest, and in the Scales type section only a few beds are dark. The Lower Depauperate Zone consists of one or several thin depauperate beds at the base or in the lower few feet of the Elgin Shale. At Valmeyer, Monroe County, depauperate beds occur at the base of the shale and as much as 9 feet above the base. A similar depauperate bed, the Upper Depauperate Zone, occurs in the upper part of the Elgin Shale Member. It was formerly exposed in the Goose Lake clay pit in Grundy County but is now covered. At Goose Lake it is 60 feet above the base of the Scales Shale, is 20 feet below the top, and is overlain by shale and argillaceous limestone containing *Isotelus*, which forms the top of the member. The Upper Depauperate Zone has been encountered in borings only in central and northeastern Illinois.

Clermont Shale Member—The Clermont Shale Member of the Scales Shale (Calvin, 1906, p. 60, 98), the upper member, is named for Clermont, Fayette County, Iowa. It is dominantly gray shale overlying the zone of interbedded shale and limestone in the upper part of the Elgin Shale Member. Where that zone cannot be distinguished, which is commonly the case in subsurface, it is not differentiated. It is generally